Center Independent Research & Development: GSFC IRAD

Distributed Spacecraft Mission (DSM) Design Reference Framework and Testbed for Intelligent and Collaborative Constellations (ICC) (DSM-C)

Completed Technology Project (2016 - 2018)

Project Introduction

Under a changing technological and economic environment, there is growing interest in implementing future NASA missions as Distributed Spacecraft Missions (DSM), particularly as constellations of CubeSats, MicroSats and MiniSats for Earth science, heliophysics, plametary and astrophysics missions. A "Distributed Spacecraft Mission (DSM)" is a mission that involves multiple spacecraft to achieve one or more common goals.

A constellation is the most general form of DSM, with two or more spacecraft placed into specific orbit(s) for the purpose of serving a common objective (e.g., THEMIS, TROPICS and CYGNSS). A specific type of constellation is an ***Intelligent and Collaborative Constellation (ICC)***, that involves the combination of real-time data understanding, situational awareness, problem solving, planning and learning from experience, combined with communications and cooperation between multiple spacecraft in order to take full advantage of various sensors distributed on multiple platforms. For this activity, we define a Design Reference Framework for the ICC class of DSM for which requirements can be derived and used to focus technology development. The objective of this activity is to make marked and demonstrable progress in developing and/or maturing the technologies that will be necessary to design, develop, launch and operate DSMs, particularly ICCs.

In this project, we will build an end-to-end DSM-ICC framework and testbed, facilitating the integration of multiple technologies, including software and hardware subsystems and some developed in the area of communications and GN&C.

Anticipated Benefits

Multipoint measurement missions can provide a significant advancement in science return, and this science interest coupled with many recent technological advances is driving a growing trend in implementing future NASA missions as DSMs. While many missions are being developed as constellations of CubeSats and SmallSats, it is becoming increasingly evident that the full potential of such DSM will only be realized when these constellations become Intelligent and Collaborative Constellations (ICC).

Past, Current and Future Distributed Spacecraft Missions (DSM)

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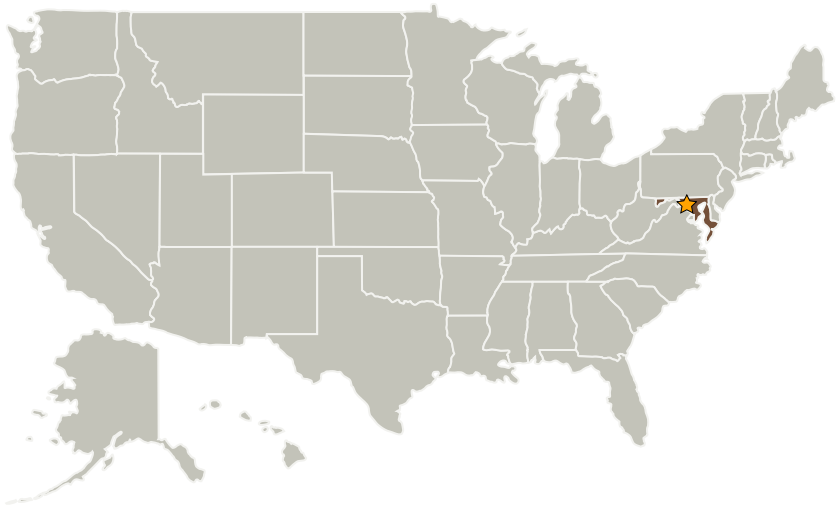
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

October 2016: Project Start

September 2018: Closed out

Closeout Summary: A framework and testbed for Intelligent and Collaborative Constellations will be built, using a scenario involving several spacecraft and a s cience event of interest that will be need to be recognized and processed "onboa rd" to enable retargeting of another spacecraft or sensor. An initial framework w as successfully demonstrated in the lab in FY17 and will be extended in FY18.

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Jacqueline J Le Moigne-stewart
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Principal Investigator:

Jacqueline J Le Moigne-stewart

Co-Investigators:

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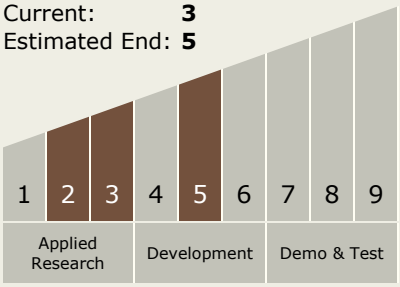
Images

Distributed Spacecraft Missions (DSM)
Past, Current and Future Distributed Spacecraft Missions (DSM)
(https://techport.nasa.gov/image/26395)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **5**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.5 Mission Architecture, Systems Analysis and Concept Development
    - TX11.5.1 Tools and Methodologies for Defining Mission Architectures or Mission Design

Other/Cross-cutting:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.3 Distributed Aperture
- TX11 Software, Modeling, Simulation, and Information Processing

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Distributed Spacecraft Mission (DSM) Design Reference Framework and Testbed for Intelligent and Collaborative Constellations (ICC) (DSM-C)

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Technology Areas *(cont.)*

- TX11.3 Simulation
  - TX11.3.2 Integrated System Lifecycle Simulation

Target Destinations

The Sun, Earth, Others Inside the Solar System

Supported Mission Type

Projected Mission (Pull)